Patent Application of

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for

TITLE: EXTERNAL ROTOR GAS TURBINE

CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

Not applicable

BACKGROUND--FIELD OF INVENTION

This invention relates to gas turbine engines, specifically to external rotor reaction jet gas turbine engines.

BACKGROUND--DESCRIPTION OF PRIOR ART

Brayton thermodynamic cycle internal combustion engines can be categorized by the type of machinery used to compress air and expand combustion gases. The common turbomachinery engine will have a finely bladed internal rotor dynamic compressor to compress air powered by a similar device to expand combustion gases. Unlike the centrifugal or axial compressors, however, the blades of the turbine are completely immersed in hot combustion gases. Extraordinary efforts at developing advanced alloys and sophisticated cooling techniques are necessary to keep the turbine blades operating at reasonably high inlet temperatures and efficiencies. Up to

twenty five percent of compressor air is wasted in film cooling of some high performance gas turbine engines. Not only is the engine expensive to design and build, the overall efficiency is reduced by up to ten percent. Moreover, rotor tip clearance leakage losses are significant in an engine that must operate over a range of temperatures including cold start up.

Eliminating the bladed internal rotor of the gas turbine engine has, therefore, been a goal of many inventors for decades~~.~~

McNaught (U. S. Pat. No. 2,592,938) develops rotational shaft work to power a compressor by expanding com~~bustion~~ gases through nozzles mounted on the periphery of a pressure vessel for a jet reaction turbine. The conventional internal rotor compressor, however, requires a heavy external spinning linkage shell in order to be powered by the turbine. The engine is im~~practical to fab~~ricate or operate.

More recently, Lawler (U. S. Pat. No. 6,347,507) mounted ram jets on the tip of a rotor and eliminated, not only the internal rotor of the turbine but the internal rotor of the compressor as well. The philosophy behind what was intended to be the ultimate low tech engine is then promptly contradicted by a high tech rotor which must withstand the enormous rotational stresses due to Mach 2.5 tip speeds. In addition to air friction losses, fuel delivery or exhaust gas problems, the engine has what might be considered contradictory design points in a conventional engine. Since both propulsive efficiency and pressure ratio are always a function of the same parameter, tip speed, the engine designer has limited options to maximize overall efficiency.

BRIEF SUMMARY OF THE INVENTION

The above problems are elegantly eliminated by the external rotor compressor in pending patent application Ser. No. 60/273,426 for an external rotor gas turbine. As with the McNaught and Lawler engines the internal rotor bladed element is eliminated thereby reducing the surface area of the expanding combustion gases, and, therefore, the film cooling requirements by an order of magnitude. Unlike the McNaught engine, however, the need for complicated rotating structures and seals is eliminated because the external rotor turbine on this engine is either attached to, or integral with, an external rotor dynamic compressor. The entire outside casing of the engine spins. Unlike the Lawlor engine, the dynamic compressor allows the engine designer to select and operate at any compression ratio over a broad range of tip speeds. The rotational stresses are greatly reduced at an optimum design point. With a counter rotating impulse turbine, rotational stresses may be reduced by up to an order of magnitude.

Chamis 6,393,831

The high speed aircraft engine embodiment allows for top end speeds of a ram jet with ground take off capability.

BRIEF DESCRIPTION OF THE DRAWINGS

Add 100 to numerals for Fig. 4 dated per letter 9/1/02

Fig. 1 A cross section along the axis of the center of rotation of a prime mover for generating rotational shaft work 18. Air enters the external rotor axial compressor from the right side of the engine 20, and, after combustion in the axially mounted combustion chamber 14, the gases then move radially out to the tip mounted nozzles 2. The kinetic energy remaining in the exhaust gas jets is recovered by a one stage counter rotating impulse turbine 8 located in a radial direction from the nozzles and geared 10 to the reaction turbine. The fuel line is placed inside the hollow shaft 16.

Fig. 2 A cross section of an aircraft engine embodiment.

Fig. 3 A cross section with the combustion taking place near the rim of the jet rotor.

DETAILED DESCRIPTION OF THE INVENTION

The external rotor compressor supplies the reaction turbine combustor with a sealless rotating source of compressed air. The reaction turbine nozzles are very similar to ram nozzles and allow for stoichiometric combustion temperatures with little or no film cooling. The fuel line, controls, pump, starter, combustor, regenerator and other peripherals could simply be routed through or mounted on the center of the compressor on the stator instead of on the outside casing in a conventional engine.

The design analysis requires only a conventional understanding of the basic principles of fluid mechanics, heat transfer, rotational stresses, and other turbomachinery fields. Except for the throat of the nozzles which may require some film cooling, the heat transfer on the outside of the spinning engine is in the same range as the inside. Computer modeling or simple rig tests can predict the exact heat transfer situation.

The external rotor gas turbine requires no scientific, technological, fabrication or other breakthroughs to design or to build. The outside of the external rotor of the axial compressor embodiment could be machined in one piece, preferably from a light alloy or titanium, then spin balanced and mounted on the internal stator. Ringed inserts alternately containing rotor and stator stages could then be loaded into the compressor. Alternatively, the compressor rotor could be built in two halves like a conventional compressor housing, and, attached with low profile radially symmetrical fittings after it is mounted onto the internal stator. The compressor could then be attached to a rotating combustor section or directly to the reaction turbine if the combustor was located in the radial flow or tip area of the engine. If film cooling was required, channels would route air from just downstream from the compressor to the nozzles.

Preferably, the nozzles in both the prime mover embodiment and the high speed thrust embodiment would be angled ten to 15 degrees the axial direction. The remaining kinetic energy would power a common axial impulse turbine for rotational shaft work or, for the high speed thrust engine, redirected aft off of stator blades.